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Voice over Internet Protocol (VoIP) Best Service Provider Decision Making with Using Hierarchical Decision Model (HDM)

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Abstract

Most technical researchers expect VoIP will lead the future communications. VoIP services are offered by a wide range of providers based on the customer's intended business or corporate need. It is thus plausible for any entity to do a well detailed research on selecting best VoIP provider that would maximize the efficiency of their work. In a hierarchical structure of a given organization the choice of VoIP is determined by the number of users through the different protocols, number of devices that are required to attain a complete network, the most lucrative choice will also be based on multi criteria of the VoIP keeping in mind that the output of the preferred VoIP should be worth its cost in terms of sustainability of service provided.

To come with a good network design, it is paramount that you familiarize with all the inner networking designs as well as the latest technology. There are many challenges that face VoIP and these can be addressed using the best decision making selection which can be arrived at using the hierarchical decision model (HDM). The model takes into account various VoIP options as outlined and judged by experts. After this step, a HDM is used as a software to compare tangible factors and rank them according to priority by means of pairwise comparison.

The analytical model consisted of levels that include: objective, criteria, sub-criteria, and alternatives which they are the main decision factors. Groups of experienced telecommunication and experts' diversity were invited from different firms to provide the correct judgement concerning the best VoIP option. From the research, the most feasible alternative was Google voice. In addition, all the other options could generate same results but were not as effective as Google voice and may require further research. It was clear from the research that following the

correct perspectives and criteria was key to successful research. The research question is what is the best selected service provider through multiple alternatives?

Introduction

VOIP stands for Voice over Internet Protocol. VOIP is a methodology and group of systematic technology of transferring of voice communication or multimedia messages over Internet Protocol (IP) networks. In simple terms, it is a phone service over the Internet. Since the invention of World Wide Web and groundbreaking research in the field of internet connectivity, man has been in the search of ease. VOIP is also a part of that step. VOIP is beneficial in such a way that this technology provides services in lower rates than traditional phone services. All you need is fast and secure internet connection. VOIP works in the following three ways.

- VOIP using an ATA

ATA stands for Analogue Terminal Adaptor. This system connects an Analogue Telephone to a VOIP Network [1].

VoIP Process:

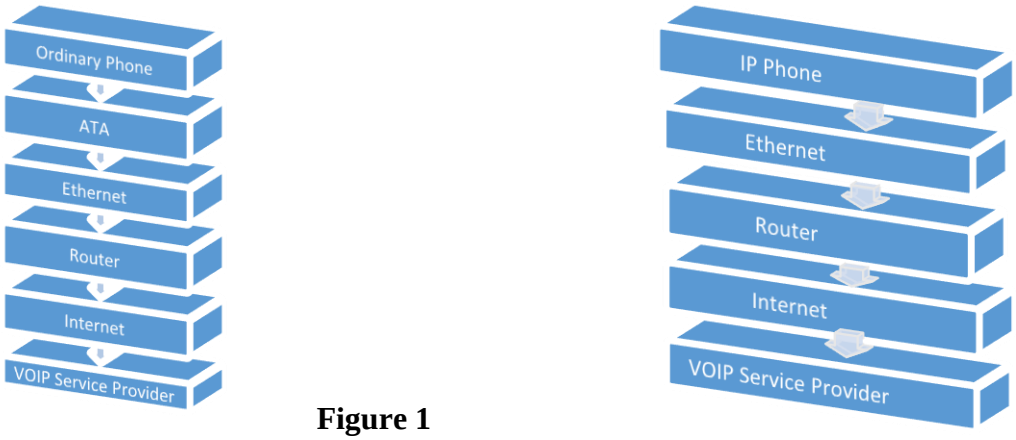
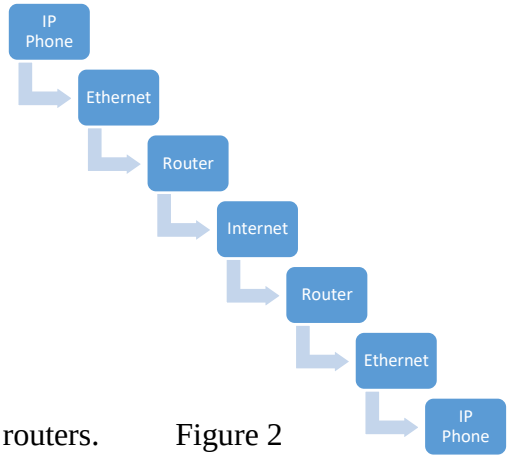


Figure 1

VOIP using an IP Phone



- VOIP Connecting Directly

In this system, it is an option to bypass through

the VOIP Service Provider and connect to a known

VOIP user. However, there devices must not be behind NAT routers. Figure 2

Why VOIP is being Used?

VOIP is mainly used because of two main reasons

- Low Working Cost
- Better Functionality

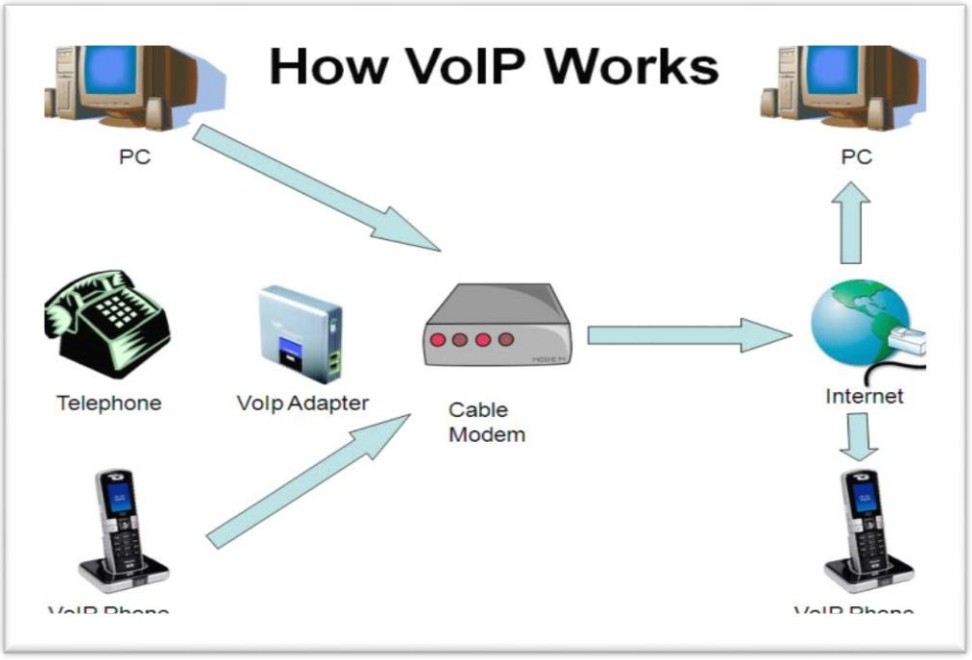


Figure: 3

Hierarchical Model

A Hierarchical Database Model is a type of data model, which organizes the data into a tree-like structure. The data is stored in the forms of records, which are inter connected to each other. A record is a collection of any field containing only one value. The records in the hierarchical database shows the relationship between the corresponding rows. This model resembles a family tree. A family tree in such a way that a parent can have many children but a child can be related to a single parent.

A hierarchical model can be helpful in finding the benefits of VoIP such as the relationship between VoIP marketing and customer needs. It is also can help us in calculating and predicting the right VOIP service provide. It shows the various parameters and constraints upon which the right VOIP provide can be forecasted. A Hierarchical Model has the following advantages.

- Clear Chain of Command
- Clear Paths of Advancement
- Specialization

In this study, the basic aim is to analyze the VOIP by using qualitative and qualitative research methodology. The VOIP will be analyzed with the aid of Hierarchical decision model. The future prospects in this field would also be discussed in the form of sensitivity analysis by keeping different kind of benefits under consideration. When choosing the most appropriate VoIP there are many variables to consider which makes the entire process a fiddly work for someone without the satisfactory knowledge in the field. Problems that are associated with technology selection are because of multiple objective variable problem, which bring about many qualitative and quantitative factors to consider.

METHODOLOGY:

In this highly competitive Voice over IP protocol services and quick technology innovations and improvement, there are many methods to test the decisions for best selecting the right company to get adapted. In this research and for getting deep decisions, I applied multi-criteria decision analysis for instance:

Hierarchical Decision Model: HDM [2].

The first methodology for selecting the best VoIP provider is HDM-hierarchical decision mode. Methodology employed in this research is hierarchical decision modeling (HDM), which is one of the widely used multi-variable decision-making methodologies Ibrahim Iskin and Tugrul U. Daim [3]. Such methodologies have also acted to help point out the most recurrent issues that are a challenge to the organization and the best way to act upon adopting resolving measures. In this research three phases of the methodology have been applied. The HDM model consist of four levels including objective level, Technology level, Strategy level, and Resource level.

Data requirement

Two instruments were utilized in this phase so as to give accurate data. The first phase involves a detailed interview process that seeks to find out from a direct source. Each of the respondents have to express their professional opinion on a face-to-face, E. mail, or call basis as stipulated in the model. The responses that they gave were printed out and they were given a chance to reevaluate their given answers in case of any reconsideration (Byun, 2001) [4]. The outcome of this phase after being

presented in process able data is applied to the second instrument of HDM. The data is used to generate the preference weights of expert validated criteria. Such criteria are often tangible or intangible in nature and are used to tank the preference weights of the given experts suggestions on VoIP. This HDM technique proved to be very useful in establishing objectives and ranking policy options. In addition, it was very resourceful in checking for inconsistencies on any of the stake holder's accounts. The practical application of this approach is very complex because of its dynamic data elicitation processes. The following is An The Final of a Hierarchical Decision Model

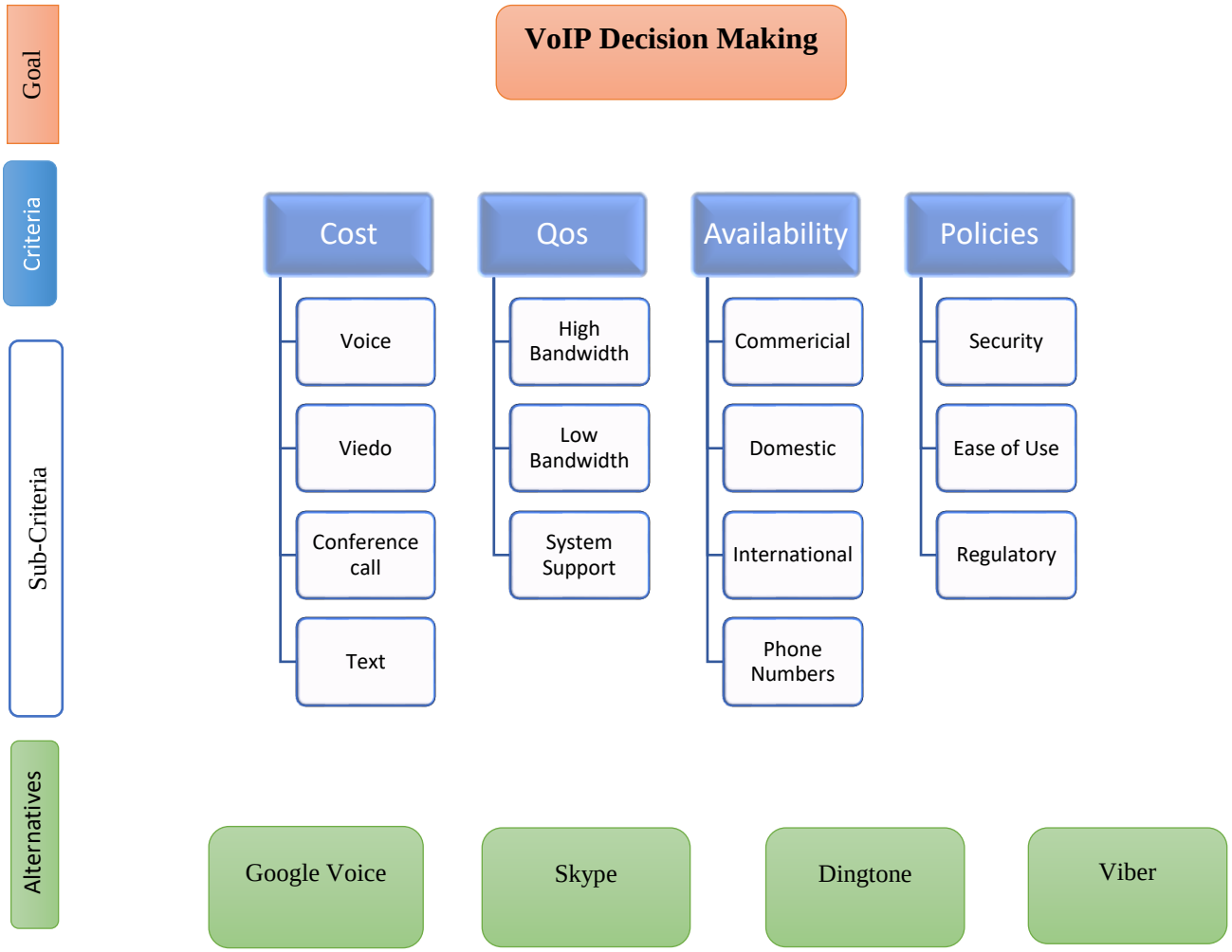


Figure: 4

The best VoIP technology is judged by experts with respect to be the best decision making selection matching the most criteria chosen in this research.

Model Definition:

The cost perspective which is in the first node at the second level is evaluated by the features the technology offers in terms of voice, video, call conferencing, and messaging. These features will form the criteria under cost perspective. For quality of services 'QoS' in the second node in the second level perspective where it is used looked at high bandwidth, low bandwidth and system support. Onwards, the Availability perspective took into account commercial, domestic, and international and phone numbers criteria. Finally, the policy perspective was marked by security and privacy, regulatory and ease of use criteria. Frankly, these are the main criteria based on the main decision factors. The alternatives expected to be/are in the market with a high level of usage according to customers satisfaction with the general criteria based on the real information.

Model alternatives definition:

A. **Google voice:**

   It is one of the important selected alternatives. Google Voice added VoIP call as a main feature for gmail giving. They provide voicemail, email, free US long distance call, allow international calls, and many features like transcripts, call blocking, call screening, conference calling, SMS, and more [5]. Known as a free user-to-user chat functions

B. **Skype**:

It is one of the major VoIP user long time ago and considered by experts to be a significant perspective. Skype is a VoIP software application. Skype is an IP telephone service provide. It also one of the fewest providers that allowed international to international calls from the beginning of the new century.[6][7].

C. **Dingtone**:

is a software mobile application for iPhone and Android with a free download. By using the app, allow customers to make free phone calls, send free text messages, and instantly share pictures, videos, and your location [8].

D. **Viber**:

Viber is a quick messaging and Voice over IP (VoIP) moblile application app for smartphones developed by Viber Media. In addition to instant messaging, users can exchange images, video and audio media messages [9].

To select best VoIP service providers from these alternatives, data source in this research and number of experts will judge based on their experiences and the information giving as categories and features comparison in the table1. [10] [11] [12].

Category or Feature	*Google Voice*	*Dingtone*	*Skype*	*Viber*	*Description*
Founded	2009	2012	2002	2010	
Voice	√	√	√	√	

Video	√	√	√	√	
Conference call	√	√	√		
Text	√	√	√	√	
Cost	From 1 cent*	From 0.91 cent*	From 2.3 cents*	*	*free from app to app
Phone numbers	√	√			They charge for getting a VoIP number
Phone Plans	No	No	No	No	
Desktop	√		√		
Phone application	√	√	√	√	Free download with no cost
System support	√	√	√	√	

Table: 1

In details, the definition and comparison between the selected services provider: Google Voice, Skype, Dingtone, Viber are going to be explained in the table , which will allow the experts use it as part of the judgment resources.

The definition of the selected criteria are as follows;

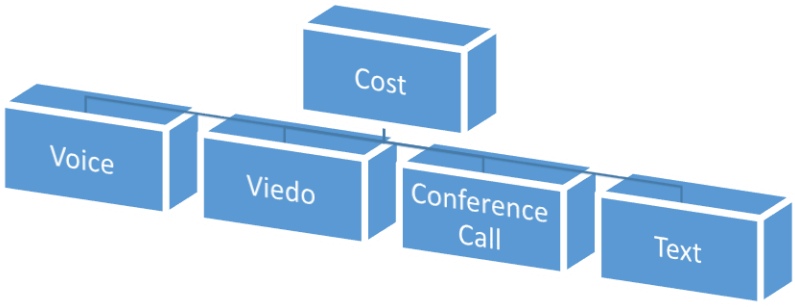


Figure: 4.1

Cost [13]**:**

1. **Voice**: This criterion establishes that the voice cost between the lines is to standards and can match the requirements of the business. It is important to note that despite the fact that dedicated broadband offers high internet connectivity, leased lines are the best when considering voice quality.
2. **Video**: Under the cost perspective, quality video transmission is an essential criterion that should be considered for the best VoIP technology. In the modern world, there are multitude tools to choose from, but the best should be the one that allows them to make and access video conference calls anytime and anywhere. That said, a mobile integrated VoIP system can help workers make direct and access video calls even when they are not in their offices.
3. **Conference Calls**: It is clear that conference calls are not for big corporations alone. The best VoIP technology for a business should be one that offers free conferencing calls between just a few people to thousands. The criterions subjects the various VoIP applications to scrutiny on the basis of their ability to support free pc to pc calls and very inexpensive calls to cell phones and to landlines.

4. **Messaging**: There is nothing annoying like realizing that the VoIP system installed in your business does not offer texting services. However, there are some VoIP providers that offer messaging services at an affordable fee using the client's mobile devices.

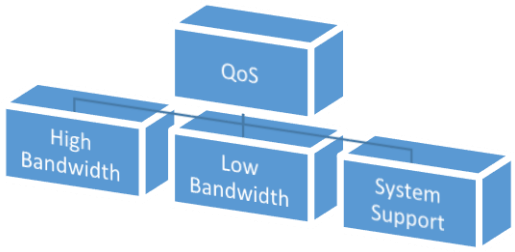


Figure: 4.2

Quality of Service[13] [14]**:**

Known as QoS, based on VoIP communication quality is a very important critera. Delay and latency cause issues to the users. QoS is varies between services. This is a key issue when analyzing the quality worthiness of a VoIP.

1. **High Bandwidth**[15]: Factors to consider here are as such as the quality of bandwidth the most preferential being the one with the highest bandwidth. This is because voice and video connections improve as the bandwidth increases.
2. **Low Bandwidth**: In evaluating cost a low bandwidth VoIP will be cheaper than the latter. The key issue here is how to guarantee that the packet traffic for the media connection will not be interfered with from other priority traffic.
3. **System support**[16]: In this category, also the system support for the VoIP is a determining factor for the overall cost. A preferable one will include a functional system support according to the opinion of the given experts.

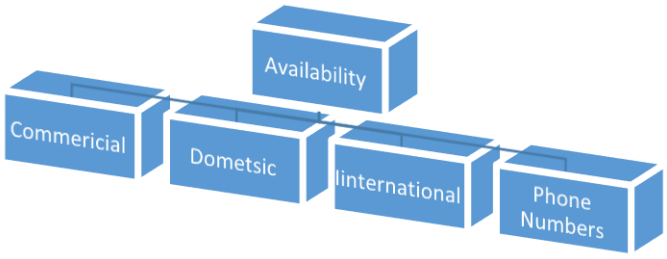


Figure: 4.3

Availability[17]

This perspective outlines that the scope of the VoIP should not be limiting in terms of where it can be used.

1. **International**[18]: The cost implication here is that the best VoIP has to have an international coverage hence can be used by travelling employees. The best VoIP offers an availability status that seeks to notify when a user is online for communication. This means that users can advertise their availability on their desk tops, mobile phones, IM, video and even conference calls hence saving on the tedious process of scheduling when to communicate. The cost implication of such a VoIP had been credited by all the interviewed experts.
2. **Commercial**: The main criteria here are the commercial availability of the VoIP and its accessibility.
3. **Domestic**: the availability of domestic call is an important criteria where it is the preference for VoIP services to make local calls inside the county.
4. **Phone numbers**: They are available in some of VoIP services where they may help to expand calls from service to another even though to main services provider like AT&A

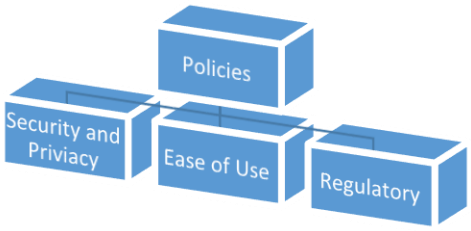


Figure: 4.4

Policies[19]

A set of ways and rules that made by VoIP services such as ease of use and Security and privacy and their regulations. Criteria to consider here is the VoIP's ease of use while utilizing improved technology.

1. **Ease of use**[20]: This has the implication that since they are replacing the analog phones they should be easier to use in terms of their call control and navigation software.
2. **Security and Privacy**[21] [22]: Another criterion is the security and privacy of the VoIP. This takes into consideration the privacy of connections from third parties who may want to hack into it. Also, keeping customers information secure and private. So, Experts guide to a VoIP with an elaborate encryption system that will secure itself from any intrusion.
3. **Regulatory**[23]: The last criteria are the regulatory measures that can be exercised on the VoIP on preference. Experts advise on a legal VoIP that is malleable to control measures. The decision making team took four VoIP technologies for the decisions alternatives and placed them at the bottom level of the hierarchy. Also, regularty important to the hottest emerging technology which is Voice over Internet Protocol (VoIP)

At the end of explanation these criteria, the decision will be based on the alternative four big services in the country such as Google Voice, Skype, Dingtone, and Viber. These are the most VoIP the customers like.

Research Objective:

Using the HDM to evaluate and select the best VoIP alternative for tourists between multiple services by analyzing different perspectives and criteria, that can be used to

- Expectation of which alternative is more preferred
- Address the criteria are most important to the service providers.

DATA AND DATA SOURCE(S)

This was applied in the choice phase of the research as recommended by the model. With a well-developed list of VoIP solutions the quantitative method of AHP was developed which entails a couple of pairwise comparisons between alternatives (Boehm, 1999) [24]. The instruments put into application here are such as the in depth interviews. Using the HDM model the in depth interviews were applied in different phases of multi criteria decisions such as pairwise comparasion and data analysis with the old literature review evaluating. The main criteria that are involved in the evaluation of the VoIP system need to be assessed with a lot of care. These factors are taken into consideration with great regard of the organizational need that evoked the need for research in the first place (Byun, 2001) [25]. First the researcher presented the different criteria proposed by the

AHP model to the experts and the discussed on the most elaborate. They also were presented with a range of some open ended questions that were majorly concerned with:

- What are he most frequently used features of the VoIP system of the company?
- What are the VoIP features that they would recommend to be adopted by the company?
- What are the different technologies in the field of VoIP and what is their advancement rate in the industry?
- What are the key advantages that come with the application of VoIP technology?
- What are the disadvantages of using the different VoIP models to the company?
- What are the special criteria applied to the evaluation of the VoIP technology so as to determine its efficiency in operation?

The questions that has been asked by experts led to the wright pairwising the comparisons of VoIP selected criteria. In briefly, the main sources of data here came from literature review evaluation, quantities analysis by using HDM model, experts' pairwise comparisons.

Expert panel

A number of selected experts who have a comprehensive knowledge and specific skills are chosen to evaluate the criteria in the HDM model. The diversity of experts were significant to evaluate and weigh the different levels of this model. To have thrir personal results, the link of HDM software sent by E- mail after contacting them to compare the criteria apples to apples till the end based on their background and experiences of using at least one of the factors. The experts are six as follows in the Table 2

Table 2 Distribution and background of expert panel [26].

EXPERTS	BACKGROUND	CONSULTING ENGINEERING COMPANY	ACADEMIA
EXPERT 1	**AT&T Telecommunication store**	**√**	
EXPERT 2	**ETM Graduate Student at Portland State University**		**√**
EXPERT 3	**ETM Graduate Student at Portland State University**		**√**
EXPERT 4	**PMI: PMP**	**√**	
EXPERT 5	**Computer Science and Electrical Engineering**		**√**
EXPERT 6	**Ph.D Scholar in Information Technology**		**√**

Model Validation:

Based on the experts first feedback, they highly recommended to add more decision making options such as adding policies and availability for the second level which is the perspective level and moving customer service to third level. Eight criteria in the third level developed and added to be more clear to have a reasonable decisions for the decision factors.as conference call, text messaging, system support, commercial, domestic, international, phone numbers, security and

privacy, ease of use and regulatory. As a result of model validation, the model tested for the first time (Appendix A) and modified as the experts recommended for the final model (Appendix A).

ANALYSIS AND KEY FINDINGS

The pairwise comparison was carried out under the guideline of a hierarchy that was systematic in creating combinations of relationships for elements in level 1, level 2, level 3, and level 4. The perspectives and the criteria elements are fourteen compared with respective to how much importance they accord the adjacent upper level. Due to different schedules of the expert weighting for the final result, the questionnaires alongside the possible pairwise comparison combinations proposed by the group were distribute d among the decision makers [27]. The hierarchical pairwise factor weight is obtained by using the pairwise comparison matrix of criteria and sub-criteria elements. From this, it is possible to compute the Eigen vector using the provided equations (Belton, 1999) [28]. After going through all the pairwise comparisons by the decision makers, aggregation of the individual judgements was done using the geometric mean. The judgement were made as per the data collected by the questionnaires. The results were then put together and analyzed using the geometric mean. A deep analysis was indicated by researchers who compared the pairs of alternatives with main criteria in the 2nd level, each sub-criterion in the 3rd level each secondary criterion in the 3th level and finally, each secondary sub-criterion in level 4. The software of our choice has the ability to synthesize local priorities in three dimensions using global priorities as the source criteria: the ideal mode and the distributive mode.

After testing the final model, experts came with a real number of pairwise comparisons such as apple to apple- criteria to criteria by using HDM model; the online software provided by the

department of engineering and technology management at Portland State University in the Appendix A.

The perspectives calculation after experts' judgments evaluations.

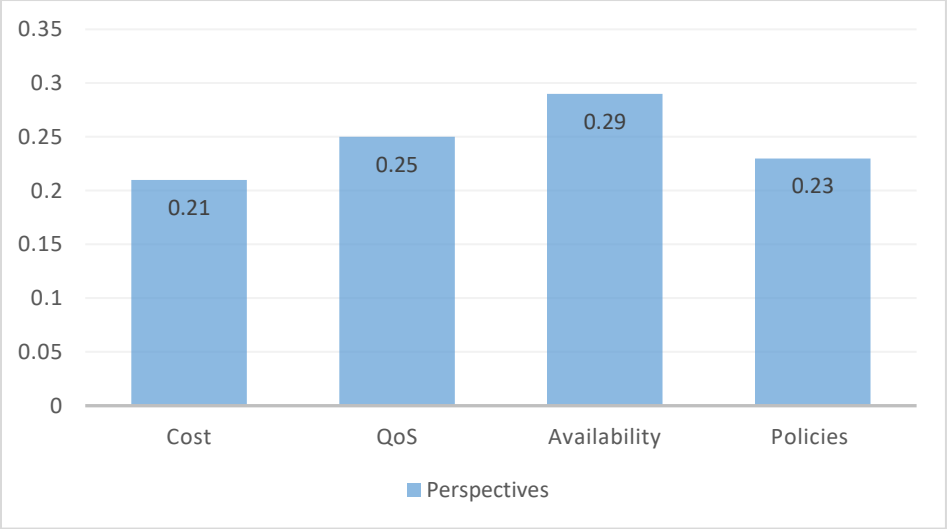


Figure: 5.Total Perspectives Weight Chart.

Based on the analysis on the chart above, we have the four main perspectives that considered for the selected alternative. The perspectives are cost, quality of service, availability and policies. The professional experts' weighing with respectively are availability, quality of service, policies, and cost as 0.29, 0.25, 0.23, 0.21. It was expected that one of the perspectives to be more preferable to experts opinion but not as the cost perspectives which is the lowest chosen with 0.21. It is really surprised that the cost is not one of the first majority for the four upcoming alternatives because users as people to people or business to business consider prices at the first moment to select their VoIP service provider. For, quality of services and policies with the rank 0.25 and 0.23 are acceptable to the expert's preference due to the significant of availability criteria. In addition, with

the busy life, most people are looking for the service provider availability without latency or delay at first, then others come after.

The Criteria weight after experts' judgments evaluations.

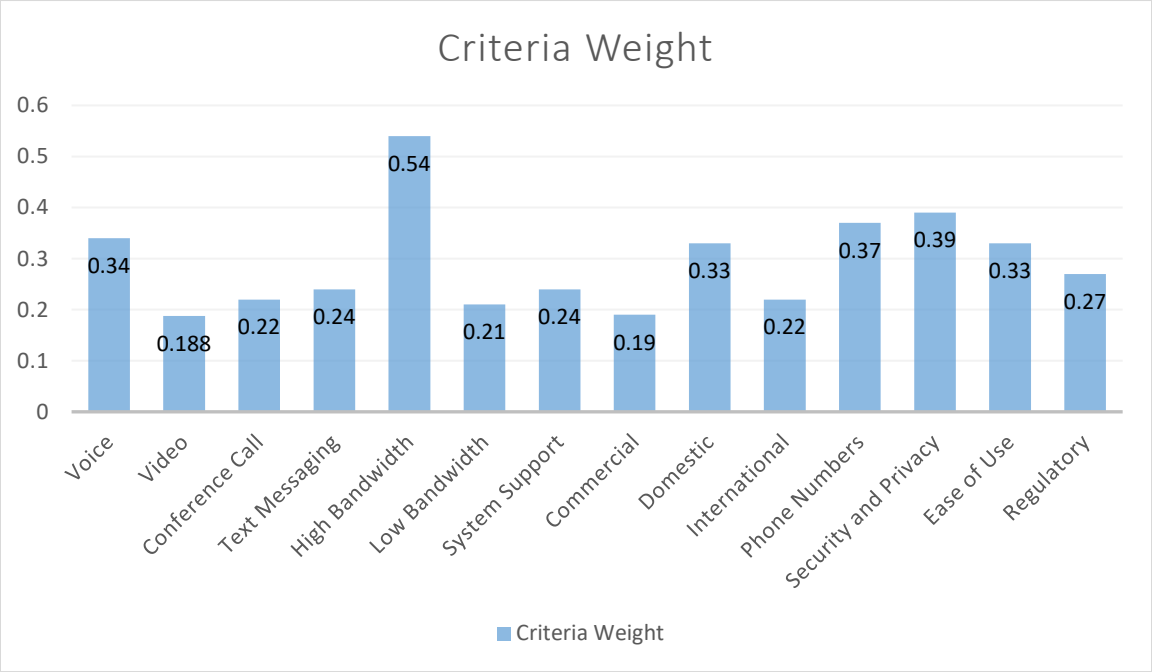


Figure 6. Total Criteria Weight Chart

HDM model is the main method for VoIP decision making and weigh by the knowledge experts. Hence, this model consists of 16 criteria were selected to evaluate and weigh the alternatives. The experts evaluate every criterion with respect to its corresponding perspective. The higher number that a criterion has, the higher its influnce on its perspective. So, In order to identify the evaluation for each criteria, a pairwise comparison was made. As a result and based on the experts' preferance and making the availability as the most important perspectives, the analysis for the above chart become more predictable for the main fourteen criteria that considered for the best-selected

alternatives. In overview for the above chart, there are a fluctuation rank for the main criteria. The highest and most important criteria is high bandwidth which is under the availability perspective with 0.54 and then security and privacy, phone numbers, voice, ease of use, domestic, regulatory, system support, text messaging, conference call, international, low bandwidth, commercial, and video calls with 0.39, 0.37, 0.34, 0.33, 0.33, 0.27, 0.24, 0.24, 0.22, 0.22, 0.21, 0.19, 0.18, respectively. In addition, the most criterion is selected by experts are high bandwidth, security and privacy, phone numbers, and ease of use. These refer to VoIP features where users like to have their calls clearly avoiding the calls traffic by the easiest way.

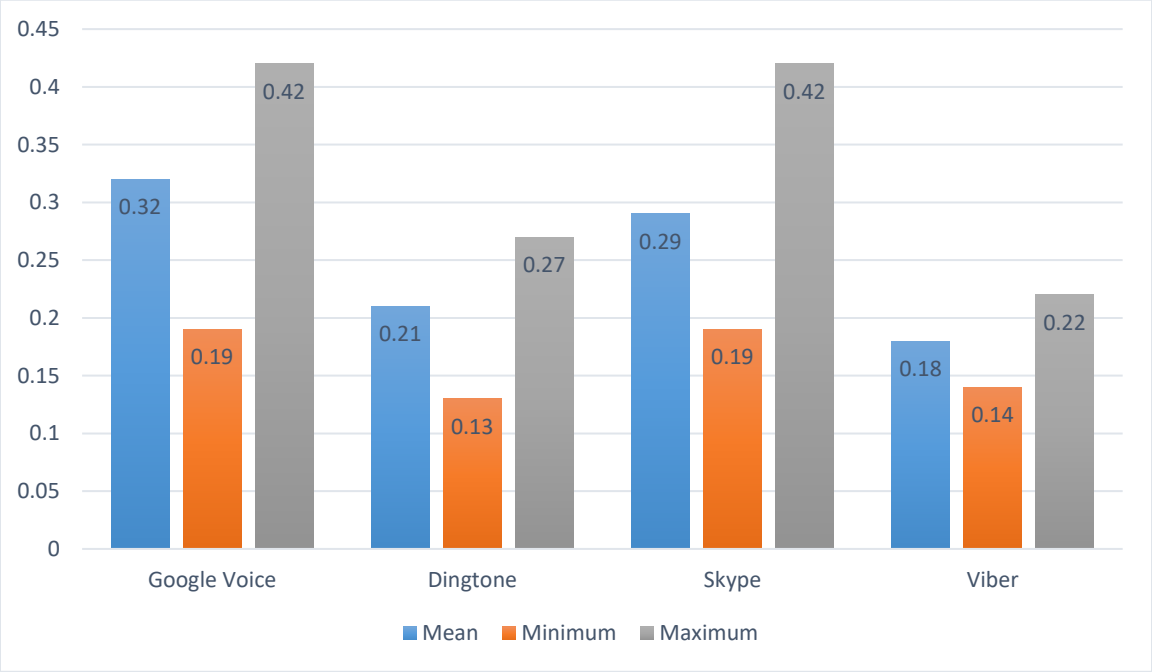


Figure 7. Alternatives Weight Figure

According to the result of the alternatives weigthing to overall objective in the chart above, the alternative weighing for Google Voice, Skype, Dingtone, and Viber are 0.32, 0.29, 0.21, and 0.18 respectively. In selecting best voice over IP protocol servise providers, Google Voice is the best alternative of voice over IP protocole for a communication between people to people or businesses to busiensses, consumer to business, individual to individual, group to group or via vers. It was completely unexpected result for Google Voice to be at first, better than the old and more experienced service provider Skype which was founded in 2002, seven years before Google Voice founded. Skype can be called now the generation of communcation since it was one of the fewest communication tool used by desktop. The googel Voice features now are much more more than other alternatives to be considered by experts. For third and fourth place of the alternatives, Dingtone is new service using one way of VoIP communication as well as Viber which they have the similar value of experts weighting with .22, 0.21. Furthermore, the table below explaine more with experts choices where four out of experts prefered Google Voice alternative and two experts for Skype alternative as the table 5 below shows:

Best VoIP Service	***Google Voice***	***Dingtone***	***Skype***	***Viber***	***Inconsistency***
Expert 1	0.37	0.27	0.21	0.15	0.04
Expert 2	0.42	0.2	0.19	0.19	0.02
Expert 3	0.31	0.21	0.3	0.18	0.04
Expert 4	0.19	0.19	0.42	0.19	0.02
Expert 5	0.38	0.13	0.35	0.14	0.05
Expert 6	0.25	0.24	0.29	0.22	0.02

Mean	**0.32**	**0.21**	**0.29**	**0.18**	
Disagreement					0.056

Table 5. Relative value of each plan based on the results of the model

Sensitive analysis:

Overall, based on table 5 and Figure 6,the over all mean for all criteria weighting is 22.143 and experts for 0.25 where that all values appears just one. By taking one of the experts off, for example; expert number 6, the over all of alternative will completely change to0.24 for the best alternatives selection from Google Voice, Skype, Dington, and Viber to Google voice, Dingtone, Viber, and then Skype. This change made Skype to be in the last preference instead of being the second preference. This change by using the equation

$$\bar{x} = \frac{1}{N}\sum_{i=1}^{N} x_i$$

Inconsistency and Disagreement

This research also demonstrates several approaches for the validation of results. Inconsistency measure, interclass correlation coefficient, and statistical test for the reliability of the experts and group agreement are used for that purpose. Finally, HDM sensitivity analysis is brought in to study the robustness of the rankings, especially at the technology level that may be caused by potential changes in the national strategic direction [29].

In this model evaluation, the level of inconsistency for all the expert's is not exceeding the 0.10 and that means they are in the acceptable range. Two of experts' inconsistency are 0.04 and the other two are below of them with the same range 0.02, but one expert got a little bit inconsistency increase with 0.05. Since they are below the valid number, they are in the acceptable rate of the model validation. The disagreement level is 0.056 which is still less than 0.10 and within the acceptable range. The inconsistency level above 0.10 occurs when the choices of the preferences are not aligned. The experts answer to each pairwise comparison should be consistent and has overall level of 0.10 and less for each expert. Inconsistency is considered as a measurement of validation for the results

FUTURE RESEARCH

One of the advantages of AHP process that keeps coming up has to do with sensitivity of the final choice in retrospective changes in the assessment of a part of the model. In future, researchers emphasize the need for there to be a series of sensitivity analyses that will help investigate how changes in priority affect the VoIP technologies. To achieve the process, there are simple guidelines that should be followed. First, the performance analysis of a software such as Expert Choice should be carried out (Boehm, 1999) [30] [31] [32]. A graphical representation of how alternatives perform with respect to all the objectives as well as the overall performance is made. A gradient sensitivity analysis indicates alternatives priorities with respect to one goal in each try.

In this research considered reducing the number of criteria at the first model and before experts validation, then the number of criteria increase on each level to clarify the alternatives well, so, the more features the VoIP has, the more attraction they would get.

At the end, many predictable researches can change the way of people communication for instance; First, it noted by one of the experts of the limitation of VoIP services, expanding VoIP providers can lead to solving the communications issues. Second, competitive companies can increase the number of VoIP features such as indicating special data plan with low cost so and high quality as well as local provider so they can change people's minded to get VoIP plan instead of the regulars sim cards.

AT the end, it is recommended that the future research should focus on evaluating a wide range of communications issues including technology.

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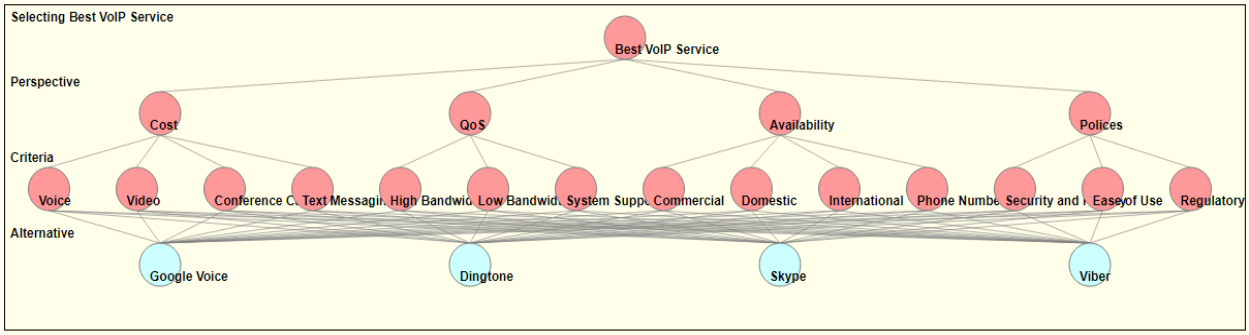
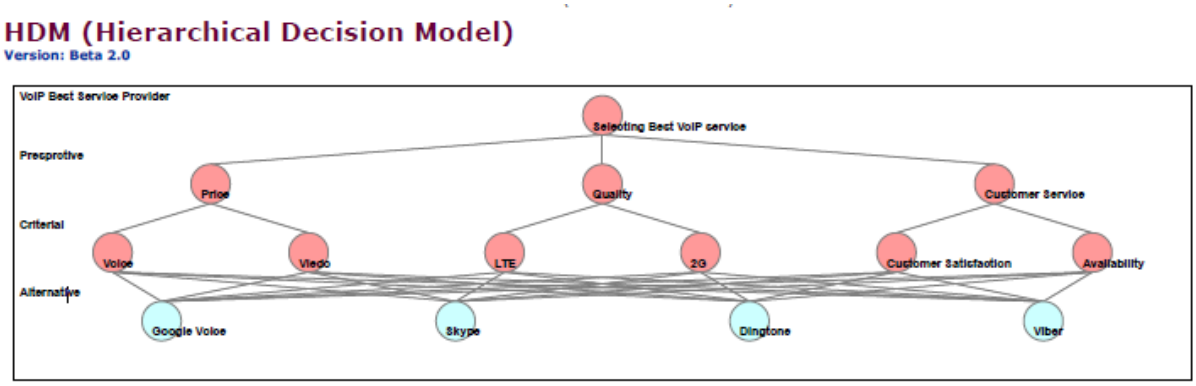
APPENDIX A – QUANTIFIED MODEL



Final Screenshot of running the model in the HDM online software at ETM



First model build before experts validatio

The Final of a Hierarchical Decision Model

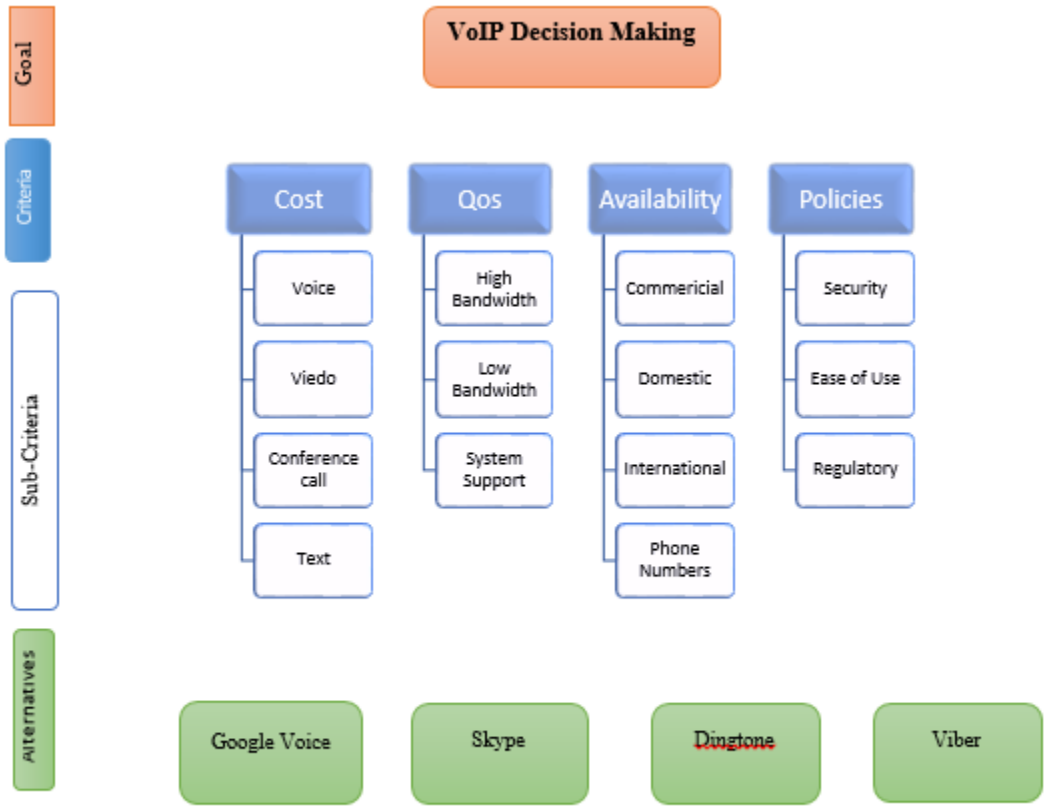


Figure: 4

APPENDIX B – AHP/HDM PCM DATA TABLES

1. Screenshot of the final results of the model

Best VoIP Service	Google Voice	Dingtone	Skype	Viber	Inconsistency
Durham Vincent	0.37	0.27	0.21	0.15	0.04
Fayez Nasser	0.42	0.2	0.19	0.19	0.02
Joseph A	0.31	0.21	0.3	0.18	0.04
Liliana Fitzpatrick	0.19	0.19	0.42	0.19	0.02
Nathalie Marquez	0.38	0.13	0.35	0.14	0.05
Shuying Li	0.25	0.24	0.29	0.22	0.02
Mean	**0.32**	**0.21**	**0.29**	**0.18**	
Minimum	**0.19**	**0.13**	**0.19**	**0.14**	
Maximum	**0.42**	**0.27**	**0.42**	**0.22**	
Std. Deviation	**0.08**	**0.04**	**0.08**	**0.03**	
Disagreement					**0.056**

The statistical F-test for evaluating the null hypothesis (Ho: ric = 0) is obtained by dividing between-subjects variability with residual variability:

Source of Variation	Sum of Square	Deg. of freedom	Mean Square	F-test value
Between Subjects:	0.08	3	.028	**4.57**
Between Conditions:	0.00	5	0.000	
Residual:	0.09	15	0.006	
Total:	**0.17**	**23**		
Critical F-value with degrees of freedom 3 & 15 at 0.01 level:				**5.42**
Critical F-value with degrees of freedom 3 & 15 at 0.025 level:				**4.15**
Critical F-value with degrees of freedom 3 & 15 at 0.05 level:				**3.29**
Critical F-value with degrees of freedom 3 & 15 at 0.1 level:				**2.49**

Screenshot of the final results of the model

Individual Analysis Results:

Expert-1 analysis results

Level-1	Best VoIP Service
Cost	0.17
QoS	0.34
Availability	0.27
Polices	0.22
Inconsistency	0.02

Level-2	Cost	QoS	Availability	Polices
Voice	0.37	0.00	0.00	0.00
Video	0.27	0.00	0.00	0.00
Conference Call	0.17	0.00	0.00	0.00
Text Messaging	0.19	0.00	0.00	0.00
High Bandwidth	0.00	0.22	0.00	0.00
Low Bandwidth	0.00	0.46	0.00	0.00
System Support	0.00	0.32	0.00	0.00
Commercial	0.00	0.00	0.22	0.00
Domestic	0.00	0.00	0.29	0.00
International	0.00	0.00	0.18	0.00
Phone Numbers	0.00	0.00	0.31	0.00
Security and Privacy	0.00	0.00	0.00	0.44
Ease of Use	0.00	0.00	0.00	0.33
Regulatory	0.00	0.00	0.00	0.22
Inconsistency	0.01	0.01	0.01	0.00

Level-3	Voice	Video	Conference Call	Text Messaging	High Bandwidth	Low Bandwidth	System Support	Commercial	Domestic	International	Phone Numbers	Security and Privacy	Ease of Use	Regulatory
Google Voice	0.34	0.41	0.39	0.41	0.41	0.23	0.47	0.35	0.37	0.34	0.38	0.45	0.35	0.33
Dingtone	0.27	0.30	0.34	0.29	0.28	0.18	0.26	0.33	0.27	0.30	0.31	0.29	0.29	0.30
Skype	0.30	0.18	0.16	0.18	0.20	0.26	0.17	0.21	0.22	0.20	0.17	0.18	0.25	0.19
Viber	0.10	0.11	0.10	0.11	0.11	0.33	0.10	0.11	0.14	0.16	0.13	0.08	0.11	0.19
Inconsistency	0.10	0.05	0.09	0.02	0.04	0.01	0.02	0.07	0.02	0.07	0.04	0.00	0.15	0.04

The final result:

Level-1	Best VoIP Service
Google Voice	0.37
Dingtone	0.27
Skype	0.21
Viber	0.15
Inconsistency	0.04

2. Expert-2 analysis results

Level-1	Best VoIP Service
Cost	0.28
QoS	0.25
Availability	0.21
Polices	0.26
Inconsistency	0.02

Level-2	Cost	QoS	Availability	Polices
Voice	0.36	0.00	0.00	0.00
Video	0.27	0.00	0.00	0.00
Conference Call	0.17	0.00	0.00	0.00
Text Messaging	0.21	0.00	0.00	0.00
High Bandwidth	0.00	0.41	0.00	0.00
Low Bandwidth	0.00	0.25	0.00	0.00
System Support	0.00	0.34	0.00	0.00
Commercial	0.00	0.00	0.17	0.00
Domestic	0.00	0.00	0.21	0.00
International	0.00	0.00	0.36	0.00
Phone Numbers	0.00	0.00	0.27	0.00
Security and Privacy	0.00	0.00	0.00	0.30
Ease of Use	0.00	0.00	0.00	0.43
Regulatory	0.00	0.00	0.00	0.26
Inconsistency	0.01	0.01	0.01	0.01

Level-3	Voice	Video	Conference Call	Text Messaging	High Bandwidth	Low Bandwidth	System Support	Commercial	Domestic	International	Phone Numbers	Security and Privacy	Ease of Use	Regulatory
Google Voice	0.45	0.42	0.51	0.49	0.44	0.56	0.48	0.22	0.43	0.40	0.41	0.43	0.35	0.34
Dingtone	0.18	0.20	0.20	0.19	0.17	0.20	0.17	0.47	0.25	0.26	0.18	0.21	0.12	0.16
Skype	0.21	0.22	0.14	0.15	0.21	0.10	0.23	0.18	0.16	0.19	0.23	0.22	0.16	0.26
Viber	0.17	0.16	0.15	0.18	0.18	0.15	0.12	0.13	0.16	0.14	0.18	0.14	0.37	0.24
Inconsistency	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.08	0.01	0.01	0.01	0.00

The final result:

Level-1	Best VoIP Service
Google Voice	0.42
Dingtone	0.20
Skype	0.19
Viber	0.19
Inconsistency	0.02

3. Expert-3 analysis results

Level-1	Best VoIP Service
Cost	0.27
QoS	0.29
Availability	0.17
Polices	0.27
Inconsistency	0.05

Level-2	Cost	QoS	Availability	Polices
Voice	0.42	0.00	0.00	0.00
Video	0.10	0.00	0.00	0.00
Conference Call	0.16	0.00	0.00	0.00
Text Messaging	0.32	0.00	0.00	0.00
High Bandwidth	0.00	0.82	0.00	0.00
Low Bandwidth	0.00	0.06	0.00	0.00
System Support	0.00	0.12	0.00	0.00
Commercial	0.00	0.00	0.16	0.00
Domestic	0.00	0.00	0.41	0.00
International	0.00	0.00	0.11	0.00
Phone Numbers	0.00	0.00	0.31	0.00
Security and Privacy	0.00	0.00	0.00	0.30
Ease of Use	0.00	0.00	0.00	0.47
Regulatory	0.00	0.00	0.00	0.23
Inconsistency	0.08	0.00	0.04	0.05

Level-3	Voice	Video	Conference Call	Text Messaging	High Bandwidth	Low Bandwidth	System Support	Commercial	Domestic	International	Phone Numbers	Security and Privacy	Ease of Use	Regulatory
Google Voice	0.33	0.27	0.30	0.33	0.33	0.37	0.36	0.17	0.21	0.15	0.26	0.37	0.42	0.23
Dingtone	0.17	0.29	0.19	0.17	0.16	0.16	0.20	0.37	0.30	0.21	0.49	0.21	0.13	0.22
Skype	0.47	0.20	0.23	0.26	0.31	0.29	0.26	0.20	0.32	0.29	0.12	0.27	0.29	0.35
Viber	0.04	0.25	0.28	0.24	0.20	0.18	0.17	0.26	0.17	0.36	0.14	0.15	0.17	0.20
Inconsistency	0.23	0.02	0.01	0.02	0.01	0.01	0.00	0.04	0.04	0.04	0.02	0.00	0.01	0.03

The final result:

Level-1	Best VoIP Service
Google Voice	0.31
Dingtone	0.21
Skype	0.30
Viber	0.18
Inconsistency	0.04

4. Expert-4 analysis results

Level-1	Best VoIP Service
Cost	0.25
QoS	0.25
Availability	0.25
Polices	0.25
Inconsistency	0.00

Level-2	Cost	QoS	Availability	Polices
Voice	0.11	0.00	0.00	0.00
Video	0.11	0.00	0.00	0.00
Conference Call	0.34	0.00	0.00	0.00
Text Messaging	0.44	0.00	0.00	0.00
High Bandwidth	0.00	0.83	0.00	0.00
Low Bandwidth	0.00	0.04	0.00	0.00
System Support	0.00	0.13	0.00	0.00
Commercial	0.00	0.00	0.31	0.00
Domestic	0.00	0.00	0.31	0.00
International	0.00	0.00	0.31	0.00
Phone Numbers	0.00	0.00	0.08	0.00
Security and Privacy	0.00	0.00	0.00	0.52
Ease of Use	0.00	0.00	0.00	0.08
Regulatory	0.00	0.00	0.00	0.40
Inconsistency	0.29	0.13	0.00	0.02

Level-3	Voice	Video	Conference Call	Text Messaging	High Bandwidth	Low Bandwidth	System Support	Commercial	Domestic	International	Phone Numbers	Security and Privacy	Ease of Use	Regulatory
Google Voice	0.17	0.17	0.25	0.25	0.14	0.30	0.17	0.14	0.14	0.14	0.14	0.25	0.25	0.25
Dingtone	0.17	0.17	0.25	0.25	0.14	0.30	0.17	0.14	0.14	0.14	0.14	0.25	0.25	0.25
Skype	0.50	0.50	0.25	0.25	0.57	0.10	0.50	0.57	0.57	0.57	0.57	0.25	0.25	0.25
Viber	0.17	0.17	0.25	0.25	0.14	0.30	0.17	0.14	0.14	0.14	0.14	0.25	0.25	0.25
Inconsistency	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The final result:

Level-1	Best VoIP Service
Google Voice	0.19
Dingtone	0.19
Skype	0.42
Viber	0.19
Inconsistency	0.02

5. Expert-5 analysis results

Level-1	Best VoIP Service
Cost	0.25
QoS	0.24
Availability	0.34
Polices	0.17
Inconsistency	0.00

Level-2	Cost	QoS	Availability	Polices
Voice	0.26	0.00	0.00	0.00
Video	0.26	0.00	0.00	0.00
Conference Call	0.26	0.00	0.00	0.00
Text Messaging	0.20	0.00	0.00	0.00
High Bandwidth	0.00	0.27	0.00	0.00
Low Bandwidth	0.00	0.38	0.00	0.00
System Support	0.00	0.35	0.00	0.00
Commercial	0.00	0.00	0.16	0.00
Domestic	0.00	0.00	0.22	0.00
International	0.00	0.00	0.30	0.00
Phone Numbers	0.00	0.00	0.33	0.00
Security and Privacy	0.00	0.00	0.00	0.47
Ease of Use	0.00	0.00	0.00	0.36
Regulatory	0.00	0.00	0.00	0.18
Inconsistency	0.00	0.07	0.01	0.00

Level-3	Voice	Video	Conference Call	Text Messaging	High Bandwidth	Low Bandwidth	System Support	Commercial	Domestic	International	Phone Numbers	Security and Privacy	Ease of Use	Regulatory
Google Voice	0.27	0.28	0.23	0.23	0.18	0.22	0.23	0.31	0.24	0.23	0.26	0.25	0.30	0.33
Dingtone	0.19	0.22	0.22	0.25	0.18	0.37	0.30	0.20	0.24	0.15	0.26	0.28	0.31	0.19
Skype	0.36	0.33	0.34	0.24	0.38	0.23	0.24	0.28	0.32	0.42	0.24	0.22	0.22	0.20
Viber	0.18	0.17	0.21	0.29	0.25	0.18	0.23	0.21	0.20	0.20	0.24	0.25	0.17	0.28
Inconsistency	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.01	0.06	0.02	0.02	0.02	0.02	0.01

The final result:

Level-1	Best VoIP Service
Google Voice	0.25
Dingtone	0.24
Skype	0.29
Viber	0.22
Inconsistency	0.02

Level-1	Best VoIP Service
Cost	0.08
QoS	0.14
Availability	0.52
Polices	0.26
Inconsistency	0.10

Level-2	Cost	QoS	Availability	Polices
Voice	0.52	0.00	0.00	0.00
Video	0.10	0.00	0.00	0.00
Conference Call	0.26	0.00	0.00	0.00
Text Messaging	0.12	0.00	0.00	0.00
High Bandwidth	0.00	0.69	0.00	0.00
Low Bandwidth	0.00	0.08	0.00	0.00
System Support	0.00	0.23	0.00	0.00
Commercial	0.00	0.00	0.14	0.00
Domestic	0.00	0.00	0.57	0.00
International	0.00	0.00	0.07	0.00
Phone Numbers	0.00	0.00	0.22	0.00
Security and Privacy	0.00	0.00	0.00	0.33
Ease of Use	0.00	0.00	0.00	0.33
Regulatory	0.00	0.00	0.00	0.34
Inconsistency	0.12	0.04	0.06	0.32

Level-3	Voice	Video	Conference Call	Text Messaging	High Bandwidth	Low Bandwidth	System Support	Commercial	Domestic	International	Phone Numbers	Security and Privacy	Ease of Use	Regulatory
Google Voice	0.38	0.40	0.37	0.37	0.36	0.37	0.33	0.36	0.45	0.32	0.35	0.31	0.29	0.42
Dingtone	0.13	0.08	0.07	0.08	0.08	0.17	0.08	0.17	0.15	0.20	0.13	0.10	0.13	0.10
Skype	0.40	0.42	0.48	0.45	0.44	0.36	0.51	0.32	0.27	0.32	0.39	0.40	0.37	0.33
Viber	0.09	0.10	0.08	0.10	0.12	0.11	0.08	0.15	0.13	0.16	0.13	0.19	0.21	0.15
Inconsistency	0.00	0.01	0.02	0.02	0.06	0.00	0.03	0.06	0.03	0.00	0.01	0.01	0.00	0.05

The final result:

Level-1	Best VoIP Service
Google Voice	0.38
Dingtone	0.13
Skype	0.35
Viber	0.14
Inconsistency	0.05

6. Expert-6 analysis results

Level-1	Best VoIP Service
Cost	0.25
QoS	0.24
Availability	0.34
Polices	0.17
Inconsistency	0.00

Level-2	Cost	QoS	Availability	Polices
Voice	0.26	0.00	0.00	0.00
Video	0.28	0.00	0.00	0.00
Conference Call	0.26	0.00	0.00	0.00
Text Messaging	0.20	0.00	0.00	0.00
High Bandwidth	0.00	0.27	0.00	0.00
Low Bandwidth	0.00	0.38	0.00	0.00
System Support	0.00	0.35	0.00	0.00
Commercial	0.00	0.00	0.16	0.00
Domestic	0.00	0.00	0.22	0.00
International	0.00	0.00	0.30	0.00
Phone Numbers	0.00	0.00	0.33	0.00
Security and Privacy	0.00	0.00	0.00	0.47
Ease of Use	0.00	0.00	0.00	0.36
Regulatory	0.00	0.00	0.00	0.18
Inconsistency	0.00	0.07	0.01	0.00

Level-3	Voice	Video	Conference Call	Text Messaging	High Bandwidth	Low Bandwidth	System Support	Commercial	Domestic	International	Phone Numbers	Security and Privacy	Ease of Use	Regulatory
Google Voice	0.27	0.28	0.23	0.23	0.18	0.22	0.23	0.31	0.24	0.23	0.26	0.25	0.30	0.33
Dingtone	0.19	0.22	0.22	0.25	0.18	0.37	0.30	0.20	0.24	0.15	0.26	0.28	0.31	0.19
Skype	0.36	0.33	0.34	0.24	0.38	0.23	0.24	0.28	0.32	0.42	0.24	0.22	0.22	0.20
Viber	0.18	0.17	0.21	0.29	0.25	0.18	0.23	0.21	0.20	0.20	0.24	0.25	0.17	0.28
Inconsistency	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.01	0.06	0.02	0.02	0.02	0.02	0.01

The final result:

Level-1	Best VoIP Service
Google Voice	0.25
Dingtone	0.24
Skype	0.29
Viber	0.22
Inconsistency	0.02